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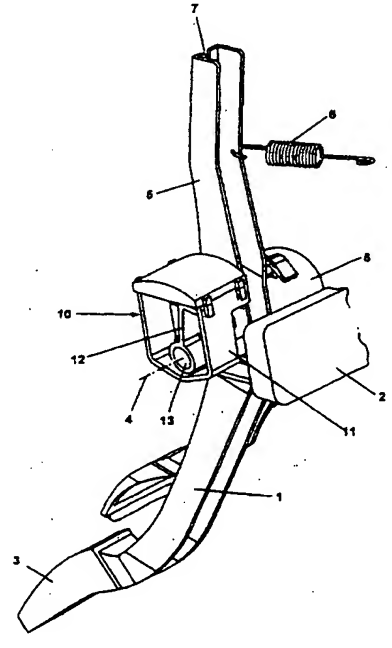
(54) Title: DAMPED PEDAL MOUNTING

(57) Abstract

A hysteresis-inducing pedal mounting for an accelerator pedal of a motor vehicle permits the hysteresis characteristic to be readily varied to meet the design parameters of the automobile in which it is to be fitted. The unit comprises a housing (11) for attachment to the accelerator pedal mounting (2) of the motor vehicle, with a lever arm (12) mounted in the housing to be movable as one with the accelerator pedal (1) over a permitted arc of pedal movement. A first friction member (16) fast to the housing (11) presents an inwardly facing curved reaction face, facing the lever arm (12) over the permitted arc of movement. A second friction member (15c) is biased radially outwardly from an end of the lever arm (12) into frictional contact with the reaction face of the first friction member (16) to create a frictional resistance to movement of the accelerator pedal (1).



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TITLE

Damped Pedal Mounting

DESCRIPTION

Field of the Invention

The invention relates to pedal mountings for the accelerator pedals of automobiles and provides a hysteresis-inducing unit for an accelerator pedal mounting which creates a desirable damped movement in use.

Background Art

Traditionally, the engine speed of an automobile has been controlled from a foot pedal, or accelerator pedal, via a rod or cable linkage to a carburettor or fuel injection system. Depression of the accelerator pedal causes an increase in the fuel supply to the engine, which thus increases speed. The rod or cable linkage has a frictional resistance to movement, which not only gives the accelerator pedal a familiar and recognizable 'feel' to the driver, but also reduces excessive oscillatory pedal movement or dither as a consequence of feedback from road shocks experienced by the moving vehicle.

A relatively recent development in automobile engine control is the introduction of the so-called 'drive-by-wire' system of engine control, in which a transducer is attached to the accelerator pedal, and the pedal position is translated by the transducer into an electrical signal which is delivered to the engine management system to control the vehicle engine speed. The electrical signal can be processed by the engine management system in order to provide the desired engine response, and it has been proposed that undue oscillatory movement of the pedal could be filtered out of the electrical signal at the engine management system. That represents an electronics-based solution to the problem of pedal dither.

Electrical processing of the accelerator pedal position signal does not, however, improve the 'feel' of an accelerator pedal which is linked to the engine and engine management system electrically rather than mechanically. Pedal mountings have therefore been proposed in which frictional forces resisting pedal movement, comparable to the frictional resistance of the traditional rod or cable linkage, are deliberately incorporated into the pedal mounting. Such mountings are designed to introduce hysteresis into the pedal movement, with a significantly larger force being required to initiate pedal movement than to maintain a constant pedal position.

One prior proposed hysteresis-inducing pedal mounting incorporates two coaxial friction discs, one associated with the pedal and the other associated with a housing for the pedal mounting. The discs are biased axially into frictional contact with each other, so as to provide a constant frictional resistance to pedal movement.

Another prior proposed hysteresis-inducing pedal mounting incorporates arcuate brake shoes spring-biased onto a pivot shaft for the accelerator pedal or onto an enlarged portion of that shaft.

An inherent characteristic of all prior proposed hysteresis-inducing pedal mountings is that the induced hysteresis, or frictional resistance to pedal movement, is constant over the entire range of pedal movement. Furthermore the two examples quoted above introduce frictional forces close to the pivotal axis of the pedal, so that in order to create a significant resistance to pedal movement the spring forces must be very substantial.

It is an object of the invention to provide a hysteresis-inducing pedal mounting which permits the hysteresis characteristic to be readily varied to meet the design parameters of the automobile in which it is to be

fitted, and which permits lighter springs to be used than in prior proposed mountings, while maintaining the unit of a size that can be fitted in the driver's footwell of a motor vehicle in the relatively limited space available.

It is a further object of the invention to provide a hysteresis-inducing unit that can be attached to an accelerator pedal mounting to impart a damped hystereis characteristic and 'feel' to the accelerator pedal when that pedal is used in a 'drive-by-wire' engine control system.

The Invention

The invention provides a hysteresis-inducing unit for an accelerator pedal mounting of a motor vehicle, comprising: a housing for attachment to the accelerator pedal mounting, a lever arm mounted in the housing to be movable as one with the accelerator pedal over a permitted arc of pedal movement, a first friction member fast to the housing and presenting an inwardly facing curved reaction face, facing the lever arm over the permitted arc of movement of the lever arm, and a second friction member biased radially outwardly from an end of the lever arm into frictional contact with the reaction face, to create a frictional resistance to movement of the accelerator pedal.

The inwardly facing curved reaction face of the first friction member may be arcuate, with the centre of arc being the pivotal axis of the accelerator pedal and lever arm. That creates a uniform hysteresis characteristic over the range of pedal movement. Alternatively the reaction face may be of a curved shape which has a different radial spacing from the pedal pivotal axis for different pedal angles, so as to provide a non-uniform hysteresis characteristic over the range of pedal movement. For example, the reaction face may be closer to the pedal axis at one end, corresponding to maximum pedal

depression, than at the other, corresponding to minimum pedal depression. Moreover the spacing from the axis may vary uniformly or non-uniformly over the angular extent of the reaction face. The consequence of such a design of reaction face would be that the second friction member would be more strongly biased into frictional contact with the reaction surface for maximum pedal depression than for minimum pedal depression. The damping effect of the unit on pedal movement would therefore be greater for higher engine speeds than for lower engine speeds. No other hysteresis-inducing unit provides, at low cost, such a total control over the applied hysteresis characteristic imposed by the unit.

The second frictional member may be a member longitudinally movable relative to the lever arm and spring-biased radially outwardly from the distal end of the lever arm. The spring bias may be by a coil or leaf spring or other resilient means. A preferred and highly cost-effective second frictional member is, however, a steel leaf spring mounted at its ends on the distal end of the lever arm and resiliently presenting a portion intermediate its ends into direct frictional engagement with the reaction face of the first frictional member.

The frictional characteristics of the first and second friction members should be such as to provide a resistance to relative movement but not to prevent relative movement. High friction facings are not therefore necessary. Preferably the first friction member is made as an injection moulding from an acetal resin, such as that commercially available under the Trade Mark DELRIN, which has good wear resistance and is self-lubricating so as to give a very constant and reproducible frictional characteristic.

The length of the lever arm, the bias force on the second friction member and the frictional characteristics of the

first and second friction members together dictate the degree of damping which the unit creates. The unit may be mounted with the lever arm extending generally upwardly from the pivotal axis of the accelerator pedal, so as to extend into a void space which is generally available, or which can be made available by design, on a motor vehicle. The availability of this void space means that the length of the lever arm can be extended to allow for the use of correspondingly reduced spring bias pressures between the friction members.

Generally speaking a position transducer for the accelerator pedal, such as a potentiometer, is mounted coaxially with the pivotal axis of the accelerator pedal on one side of the pedal, and the unit according to the invention can be mounted on the opposite side of the pedal.

Drawings

Figure 1 is a perspective view of an accelerator pedal of a motor vehicle, with a hysteresis-inducing unit according to the invention mounted thereto;

Figure 2 is a front elevation of the pedal mounting of Figure 1, showing a pedal position-responsive transducer on one side and the unit according to the invention on the other side of the pedal; and

Figure 3 is a transverse section through the hystereis-inducing unit of Figures 1 and 2.

In Figure 1, one wall of the hysteresis-inducing unit of the invention has been shown cut away so as to expose the lever arm within the unit for the purpose of illustration only.

Figure 1 shows an accelerator pedal 1 pivotally supported by a mounting 2. At a lower end of pedal 1 is a foot-engageable pad 3, depression of which causes the pedal 1 to move pivotally about a pivot axis 4. On the

opposite side of the pivot axis 4 to the foot pad 3, the pedal has an integral lever arm 5 which receives one end of a return spring 6 the opposite end of which is anchored to a reaction member, not shown, fast to the vehicle body.

The pedal 1 illustrated in Figure 1 is a universal design which can be used with a cable transmission to the engine speed control mechanism or with an electrical transmission. If a cable transmission were used, then one end of the transmission cable would be anchored in a receiving recess 7 at the top of the lever arm 5. As illustrated, however, the pedal 1 is provided with an electrical transmission link. A potentiometer 8 is mounted on one side of the pedal 1 (the left hand side as seen from the driver's position) co-axial with the pivotal axis 4. The electrical output of the potentiometer 8 is a direct measure of the pedal position, and is transmitted by wire (not shown) to the engine management system of the vehicle.

In order to provide the pedal 1 with the appropriate 'feel' to the driver, even in the absence of a cable link to the engine compartment of the vehicle, there is provided a hystereis-inducing unit 10 according to the invention, mounted coaxially with the pivot axis 4 on the opposite side of the foot pedal 1 to the potentiometer 8 (see particularly Figure 2).

The unit 10 comprises a housing 11 fast to the mounting 2. Within the housing 11 is a lever arm 12 secured to a pivot shaft 13 of the accelerator pedal 1 and movable as one with the accelerator pedal 1. Figure 3 most clearly illustrates the shape and disposition of the lever arm 12. At its distal end 14 it carries a leaf spring 15 made from spring steel. The two opposite ends 15a, 15b of the leaf spring 15 bear on the lever arm 12 and an intermediate portion 15c is resiliently biased against a curved inwardly facing surface of a friction pad 16. The

friction pad 16 forms a first friction member of the hysteresis-inducing unit 10 and the intermediate portion 15c of the leaf spring 15 forms a second friction member. Pedal movement causes the second member 15c to slide over the first, with a frictional resistance to movement, thus simulating the frictional resistance to movement of a conventional cable transmission to the engine compartment.

Accurate control of the hysteresis effect induced by the unit 10 is possible because the lever arm 12 can be made of a length sufficient to create a desirable damping effect even when using a relatively light spring 15. The surface of the spring 15 is smooth, so that it can slide over the internally facing curved face of the friction pad 16 with a smooth frictional drag. The smoothness of movement may be enhanced by making the friction pad 16 of a smooth surfaced self-lubricating material such as DELRIN (Trade Mark) polyacetal.

The internally facing curved face of the friction pad 16 may be arcuate, centred around the axis 4, in which case the preloading force of the spring 15 is constant for all degrees of angular movement of the pedal 1. That gives a hysteresis characteristic or pedal damping effect which is uniform over the whole range of pedal movement. That may be desirable in some installations. In other vehicle designs, however, it may be desirable to have the hysteresis characteristic vary with progressive pedal movement. For example, a greater drag factor on pedal movement may be desirable for higher vehicle speeds (and therefore engine speeds) than for lower. That can readily be accommodated by the unit 10, by shaping the internally facing curved face of the friction pad 16 so that it is non-arcuate, or arcuate but not centred around the axis 4, so that at maximum pedal movement the spring 15 is more highly compressed than at minimum pedal movement.

It is a significant advantage of the unit according to the invention that the hysteresis characteristic imparted to the pedal can be changed simply by changing the shape of the friction pad 16. The pad 16 is therefore designed as a simple clip-on component to an otherwise standardized design of housing 11. Differently shaped pads 16 can be provided for different motor vehicles.

Another significant advantage of the unit according to the invention is that it does not protrude significantly below the pivotal axis 4. Instead, the lever arm 5 extends above the axis 4 so that the unit is positioned substantially wholly in the void space above the pedal mounting 2, where conventionally such void space is available and where the unit does not interfere with the driver's foot movement.

CLAIMS

1. A hysteresis-inducing unit for an accelerator pedal (1) mounted on an accelerator pedal mounting (2) of a motor vehicle, comprising:

a housing (11) for attachment to the accelerator pedal mounting (2);

a lever arm (12) mounted in the housing (11) to be movable as one with the accelerator pedal (1) over a permitted arc of pedal movement;

a first friction member (16) fast to the housing (11), and presenting an inwardly facing curved reaction face, facing the lever arm (12) over the permitted arc of movement of the lever arm (12); and

a second friction member (15c) biassed radially outwardly from an end of the lever arm (12) into frictional contact with the reaction face, to create a frictional resistance to movement of the accelerator pedal (1).

2. A unit according to claim 1, wherein the inwardly facing curved reaction face of the first friction member (16) is arcuate, with the centre of arc being the pivotal axis (4) of the accelerator pedal (1) and lever arm (12).

3. A unit according to claim 1, wherein the inwardly facing curved reaction face of the first friction member (16) is of a curved shape which has a different radial spacing from the pivotal axis (4) of the accelerator pedal (1) and lever arm (12) for different pedal angles, so as to provide a non-uniform hysteresis characteristic over the range of pedal movement.

4. A unit according to claim 3, wherein the reaction face is closer to the pedal axis (4) at the end corresponding to maximum pedal depression than at the other end, corresponding to minimum pedal depression.

5. A unit according to claim 2, wherein the second frictional member (15c) is a member longitudinally movable relative to the lever arm (12) and spring-biassed radially outwardly from the distal end of the lever arm (12).

6. A unit according to claim 5, wherein the means biassing the second friction member (15c) into frictional contact with the reaction face is a coil or leaf spring.

7. A unit according to claim 6, wherein the means providing the spring bias is a steel-leaf spring (15) mounted at its ends on the distal end of the lever arm (12) and resiliently presenting a portion (15c) intermediate its ends (15a,15b) into direct frictional engagement with the reaction face of the first friction member (16).

8. A unit according to claim 3, wherein the second frictional member (15c) is a member longitudinally movable relative to the lever arm (12) and spring-biassed radially outwardly from the distal end of the lever arm (12).

9. A unit according to claim 8, wherein the means biassing the second friction member (15c) into frictional contact with the reaction face is a coil or leaf spring.

10. A unit according to claim 9, wherein the means providing the spring bias is a steel-leaf spring (15) mounted at its ends on the distal end of the lever arm (12) and resiliently presenting a portion (15c) intermediate its ends (15a,15b) into direct frictional engagement with the reaction face of the first friction member (16).

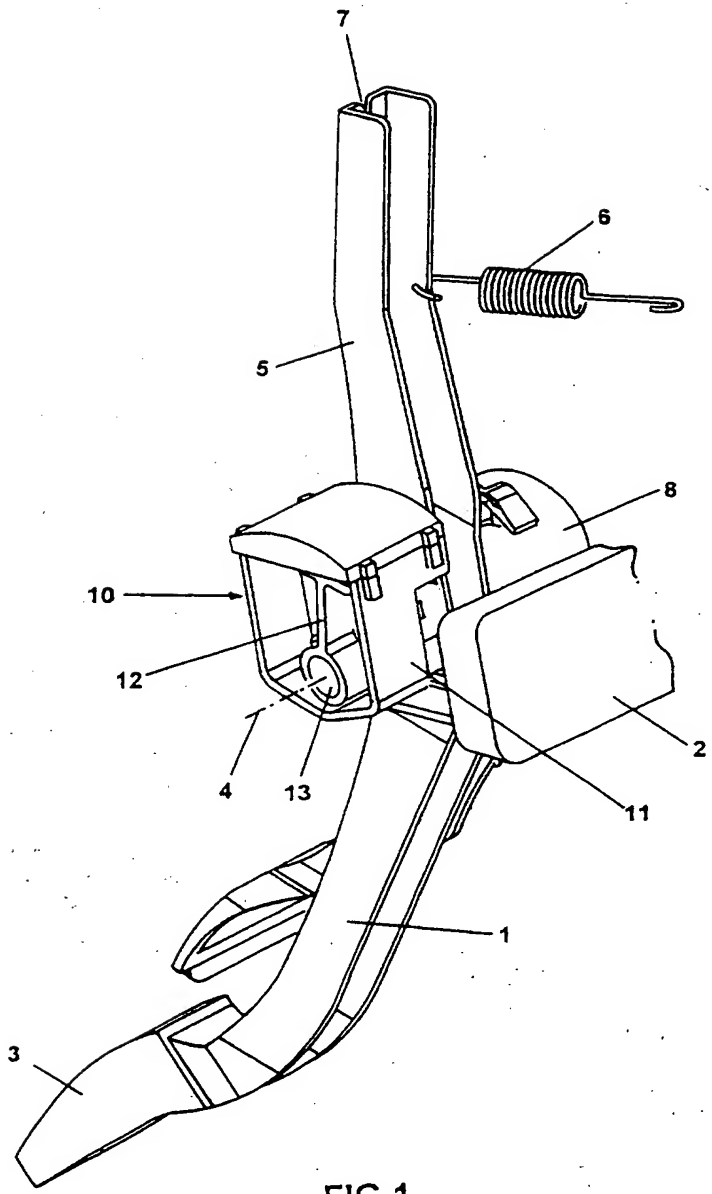


FIG.1

FIG.2

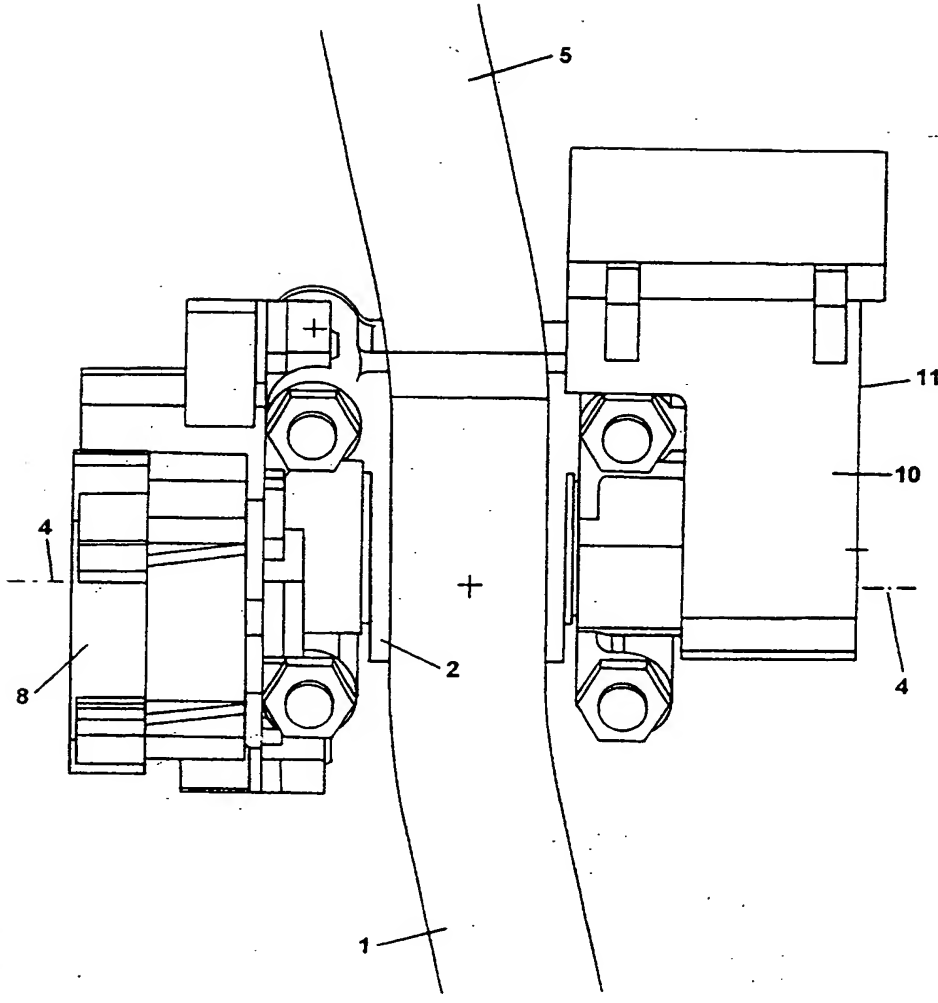
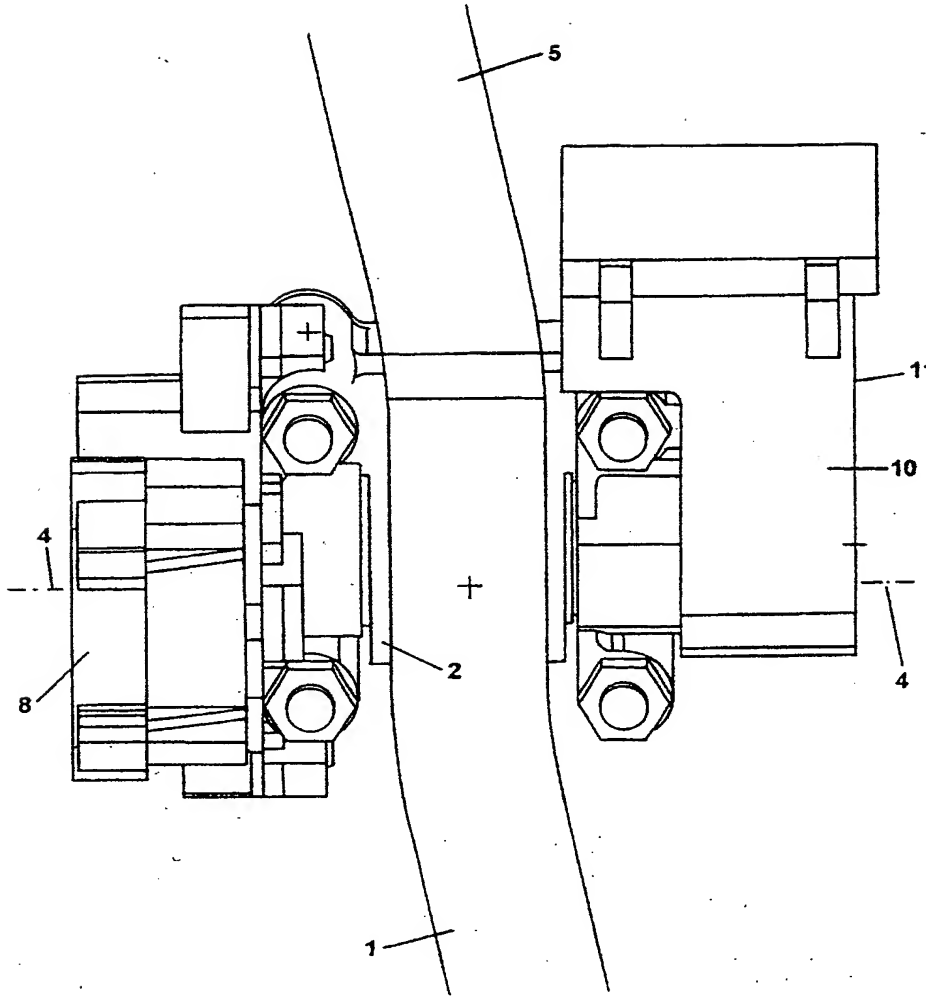


FIG.2



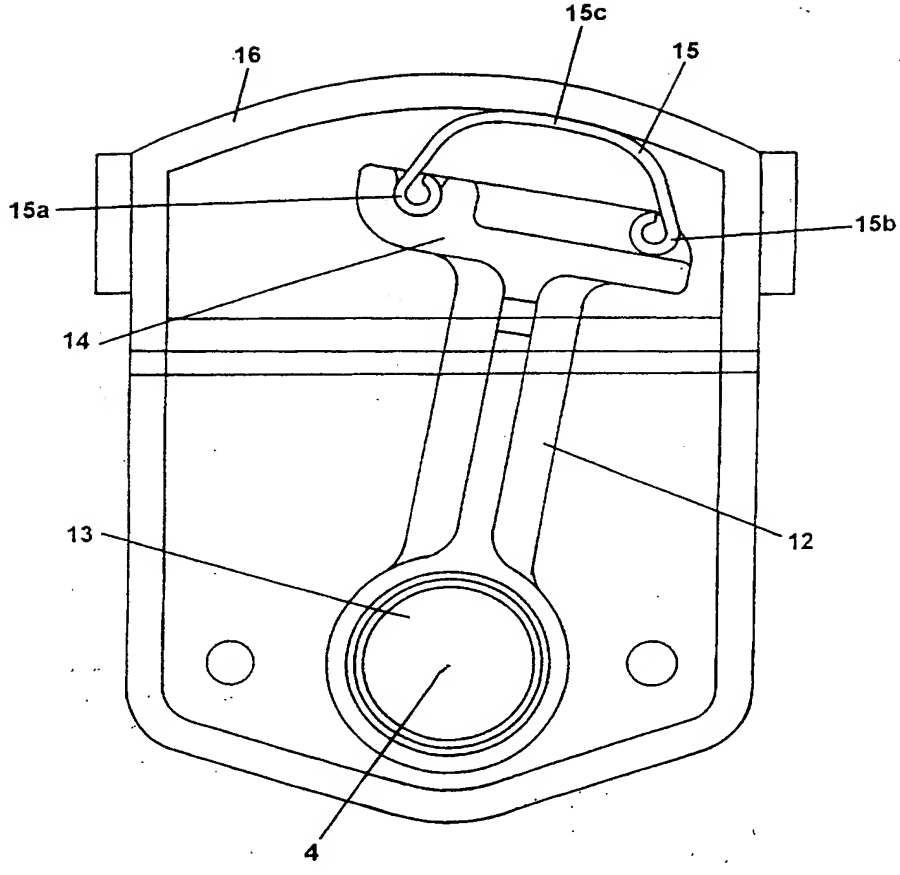


FIG.3

INTERNATIONAL SEARCH REPORT

Inter ial Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B60K26/02 G05G1/14

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B60K G05G F02D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	DE 44 07 005 C (HELLA KG) 9 March 1995 see column 3, line 29 - column 4, line 16 see figure 1	1 3,4
Y A	DE 43 00 096 A (VDO ADOLF SCHINDLING) 7 July 1994 see column 3, paragraph 3 see figure 1	3,4 1

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DE 4407005 C	09-03-95	EP 0670235 A	06-09-95
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